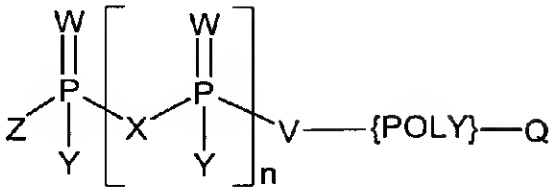
What is Claim d is:

1. A PNA derivative of Formula I



Formula I

wherein

V is oxygen, sulfur, NR_1, U-$(CR_3R_4)_{u'}$-CH_2-C(O)-NH, or U-$(CH_2CH_2O)_{u'}$-C(O)-NH;

U is, independently of any other U, oxygen, sulfur, or NH;

u' is, independently of any other u', from 1 to 10;

W is, independently of any other W, oxygen, sulfur, or NR_1;

Y is, independently of any other Y, hydroxyl, mercapto, oxyanion, thioate, or NR_1R_2,

R_1 and R_2 are, independently of each other, a radical consisting of hydrogen or C_1-C_6-alkyl;

R_3 and R_4 are, independently of each other, a radical consisting of hydrogen or a C_1-C_6-alkyl, or the radical of an amino acid side chain;

X is, independently of any other X,
U-(C_2-C_{22}-alkanediyl)-U,
U-(CH_2CH_2-O)$_{u'}$,
a bifunctional labeling group;
a bifunctional group for crosslinking with complementary nucleic acids,
a bifunctional group which promotes intracellular uptake, or
a bifunctional group which increases the binding affinity of the PNA derivative for a target nucleic acid;

Z is hydroxyl,
mercapto,
oxyanion,
thioate,
NR_1R_2,
C_1-C_{22}-alkyl,
C_1-C_8-arylalkyl,
C_1-C_{22}-alkyl-U,
C_1-C_8-arylalkyl-U,
hydroxy-C_1-C_{18}-U,
aminoalkyl-U, arylalkyl-U or mercaptoalkyl-U,
a group of the formula $R_9(CH_2CH_2\text{-}O)_m$, wherein R_9 is hydroxyl, amino, or C_1-C_{22}-alkoxy, and m is from 1 to 100,
a monofunctional or bifunctional labeling group,
a monofunctional or bifunctional crosslinking group,
a monofunctional or bifunctional group which promotes intracellular uptake, or

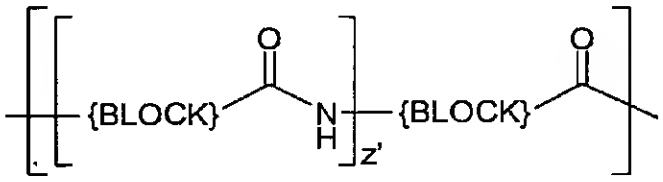
a monofunctional or bifunctional group which promotes the binding affinity of the PNA derivative for a target nucleic acid;

n is from 0 to 10;

Q is hydroxyl, amino, NHR_7, NR_7R_8, an amino acid derivative, or a peptide radical,

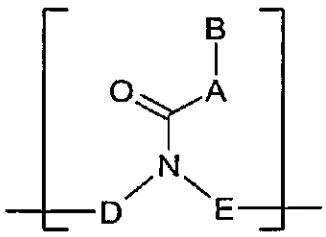
R_7 and R_8 are, independently of each other, C_1-C_{18}-alkyl or hydroxy-C_1-C_{18}-alkyl,

and wherein {POLY} is described by Formula II



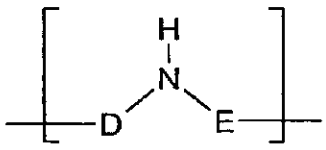
Formula II,

wherein {BLOCK} is, independently of any other {BLOCK}, described by Formula IIIA,



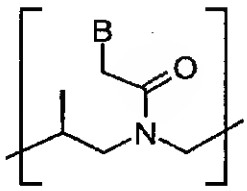
Formula IIIA

Formula IIIB,

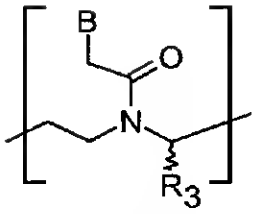


Formula IIIB

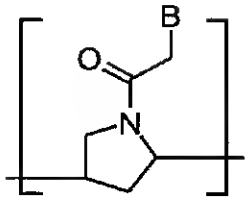
or Formulae IV A to IV G,



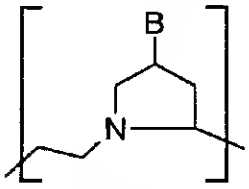
Formula IV A



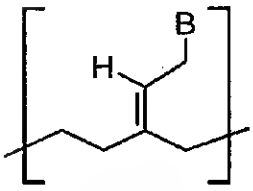
Formula IV B



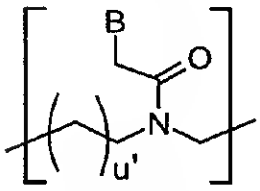
Formula IV C



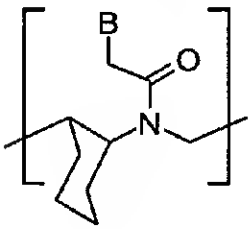
Formula IV D



Formula IV E



Formula IV F



Formula IV G

wherein each building block {BLOCK} can be different,

and wherein

z' is from 0 to 100;

A is, independently of any other A, $(CR_1R_2)_s$, wherein s is from 1 to 3;

B is, independently of any other B,
an aromatic radical which optionally possesses heteroaromatic character,
hydrogen,

hydroxyl,
C_1-C_{18}-alkyl,
or a nucleobase or its prodrug form,
wherein at least one B radical is a nucleobase;

D is, independently of any other D, $(CR_3R_4)_t$, wherein t is from 2 to 10, wherein two adjacent R_3 and R_4 radicals can form a C_5-C_8-cycloalkyl ring;

E is, independently of any other E, $(CR_5R_6)_{u'}$,

R_5 and R_6 are, independently of each other, a radical consisting of hydrogen or C_1-C_6-alkyl, or an amino acid side chain, wherein two adjacent R_5 and R_6 radicals can form a C_5-C_8-cycloalkyl ring or a spiro compound, and

wherein R_1, R_2, R_3, R_4, and u' are as defined above;

and physiologically tolerated salts of the PNA derivative of the Formula I,

with the proviso that at least one Y or Z radical is hydroxyl, mercapto, oxyanion, or thioate.

2. A PNA derivative as claimed in claim 1, wherein at least one Y or Z radical in Formula I is oxyanion or thioate in a pH range from 4.5 to 14.

3. A PNA derivative as claimed in claim 1, wherein D is $(CH_2)_2$.

4. A PNA derivative as claimed in claim 1, wherein A and E are CH_2.

5. A PNA derivative as claimed claim 1, wherein Q is a hydroxyaminoalkyl radical or a carrier sequence.

6. A PNA derivative as claimed in claim 1, wherein B is, independently of any other B, adenine, cytosine, 5-methylcytosine, guanine, thymine, uracil, purine, 2,6-diaminopurine, N^4N^4-ethanocytosine, N^6N^6-ethano-2,6-diaminopurine, 5-(C_3-C_6)-alkynyluracil, 5-(C_3-C_6)-alkynylcytosine, 5-(1-propargylamino)uracil, 5-(1-propargylamino)cytosine, phenoxazine, 9-aminoethoxyphenoxazine, 5-fluorouracil or pseudoisocytosine, 5-(hydroxymethyl)uracil, 5-aminouracil, pseudouracil, dihydrouracil, 5-(C_1-C_6)-alkyluracil, 5-(C_1-C_6)-alkylcytosine, 5-(C_2-C_6)-alkenylcytosine, 5-fluorocytosine, 5-chlorouracil, 5-chlorocytosine, 5-bromouracil, 5-bromocytosine, 7-deazaadenine, 7-deazaguanine, 8-azapurine, or a 7-deaza-7-substituted purine.

7. A PNA derivative as claimed in claim 1, wherein W is oxygen and Y is hydroxyl or oxyanion.

8. A PNA derivative as claimed in claim 1, wherein X is U-(C_2-C_{22}-alkanediyl)-U or U-(CH_2CH_2-O)$_{u'}$.

9. A PNA derivative as claimed in claim 1, wherein Z is a phosphate, a C_1- to C_{22}-radical, a C_1-C_{22}-U radical, hydroxy-C_1-C_{18}-U, an aminoalkyl-U radical, a group of the Formula R_9-(CH_2CH_2-O)$_m$, or a mercaptoalkyl-U radical.

10. A PNA derivative as claimed in claim 1, wherein X and Z are, independently of each other, biotin, fluorescein, or lexitropsin, or derivatives thereof.

11. A PNA derivative as claimed in claim 1, wherein X and Z are, independently of each other, rhodamine, TAMRA, or cyanine dye.

12. A PNA derivative as claimed in claim 1, wherein X and Z are, independently of each other, Dabcyl, psoralen, acridine, DNP, or cholesterol.

13. A PNA derivative as claimed in claim 1, wherein {POLY} comprises a nucleotide base sequence that binds to at least one sequence of at least one tumor suppressor gene, oncogene, or telomerase, or to their mRNA transcription products.

14. A PNA derivative as claimed in claim 13, wherein the base sequence of the PNA moiety is directed against the translation start of HA-ras mRNA.

15. A pharmaceutical comprising the PNA derivative as claimed in claim 1 and a physiologically acceptable carrier or excipient.

16. A process for detecting a nucleic acid of interest, said process comprising

labeling a PNA derivative as claimed in claim 1 with a detectable label, wherein the PNA derivative comprises a base sequence that specifically hybridizes with at least one sequence present in the nucleic acid of interest under selected conditions,

combining said labeled PNA derivative with a sample suspected of containing the nucleic acid of interest, and

detecting specific binding of said labeled PNA derivative to said nucleic acid of interest,
wherein specific binding indicates the presence of the nucleic acid of interest in the sample.

17. The process as claimed in claim 16, wherein the process is fluorescence in-situ hybridization (FISH).

18. The process as claimed in claim 17, wherein the nucleic acid of interest is a nucleic acid of a microorganism or virus.

19. The process of claim 17, wherein the process further comprises quantifying the detected nucleic acids.

20. The PNA derivative as claimed in claim 1, wherein the PNA derivative is an antisense agent, anti-gene agent, decoy agent, or chimeraplast agent.

21. The PNA derivative as claimed in claim 1, wherein the PNA derivative is a detection reagent.

22. A PNA chip comprising a PNA derivative as claimed in claim 1 and a substrate suitable as a solid support for fabricating a microarray.

23. A biosensor comprising a PNA derivative as claimed in claim 1 and a substrate suitable for conducting a signal from the PNA derivative to a detection device.

24. A process for preparing a PNA derivative as claimed in claim 1, wherein said process comprises

a) synthesizing a backbone for the PNA derivative, starting from the C terminus, by sequentially coupling with amidonucleic acid monomes, which are optionally N-terminally protected;

b) optionally deprotecting the N-terminally protected PNA backbone;

c) coupling a phosphorus (III) or a phosphorus (V) group to the N-terminus of the PNA backbone, using activated phosphorylating reagents optionally containing a spacer,

d) optionally repeating step c); and

e) optionally oxidizing the phosphorus (III) group to a phosphorus (V) group.

25. The process as claimed in claim 24, wherein the PNA is prepared using t-butyloxycarbonyl (BOC), 9-fluorenylmethoxycarbonyl (Fmoc), or monomethoxytrityl (Mmt) protecting groups.

26. The process as claimed in claim 25, wherein the PNA is prepared using solid supports.

27. The process as claimed in claim 26, wherein CPG, tentagel, or aminomethylpolystyrene is used as the solid support.

28. The process as claimed in claim 24, further comprising purifying the PNA derivative using chromatography or electrophoresis.

29. The process as claimed in claim 28, wherein the PNA derivative is purified using chromatography using a basic stationary phase and an acid or salt-containing eluent.

30. The process as claimed in claim 29, wherein the stationary phase is an anion exchanger or a mixed-mode phase.

31. A PNA derivative as claimed in claim 1, wherein u' is from 1 to 4.

32. A PNA derivative as claimed in claim 1, wherein u' is 1.

33. A PNA derivative as claimed in claim 1, wherein R_1 and R_2 are both hydrogen.

34. A PNA derivative as claimed in claim 1, wherein R_3 and R_4 are both hydrogen.

35. A PNA derivative as claimed in claim 1, wherein X is a bifunctional labeling group, and wherein X is fluorescein, rhodamine, TAMRA, biotin or a biotin derivative, pyrene, dinitrophenyl, acridine, cyanine dye, Dabcyl, digoxygenin, or an Edans derivative.

36. A PNA derivative as claimed in claim 35, wherein the bifunctional labeling group is a biotin derivative.

37. A PNA derivative as claimed in claim 1, wherein X is a bifunctional group for crosslinking with complementary nucleic acids.

38. A PNA derivative as claimed in claim 37, wherein X is a psoralen derivative.

39. A PNA derivative as claimed in claim 1, wherein X is a bifunctional group which promotes intracellular uptake.

40. A PNA derivative as claimed in claim 39, wherein X is cholesteryl, adamantyl, or a vitamin E derivative.

41. A PNA derivative as claimed in claim 1, wherein X is a bifunctional group which increases the binding affinity of the PNA derivative for a target nucleic acid.

42. A PNA derivative as claimed in claim 41, wherein X is acridine or a lexitropsin derivative.

43. A PNA derivative as claimed in claim 1, wherein m is from 2 to 10.

44. A PNA derivative as claimed in claim 1, wherein z is a monofunctional or bifunctional labeling group.

45. A PNA derivative as claimed in claim 44, wherein z is fluorescein, rhodamine, TAMRA, biotin or a biotin derivative, pyrene, dinitrophenyl, acridine, cyanine dye, Dabcyl, digoxygenin, or an Edans derivative.

46. A PNA derivative as claimed in claim 45, wherein z is a biotin derivative.

47. A PNA derivative as claimed in claim 1, wherein z is a monofunctional or bifunctional crosslinking group.

48. A PNA derivative as claimed in claim 1, wherein z is a psoralen derivative.

49. A PNA derivative as claimed in claim 1, wherein z is a monofunctional or bifunctional group which promotes intracellular uptake.

50. A PNA derivative as claimed in claim 49, wherein z is cholesteryl, adamantyl, or a vitamin E derivative.

51. A PNA derivative as claimed in claim 1, wherein z is a monofunctional or bifunctional group which promotes the binding affinity of the PNA derivative for a target nucleic acid.

52. A PNA derivative as claimed in claim 51, wherein z is a lexitropsin derivative.

53. A PNA derivative as claimed in claim 1, wherein n is from 0 to 10.

54. A PNA derivative as claimed in claim 1, wherein n is from 0 to 3.

55. A PNA derivative as claimed in claim 1, wherein z' is from 0 to 100.

56. A PNA derivative as claimed in claim 1, wherein z' is from 1-20.

57. A PNA derivative as claimed in claim 1, wherein z' is from 4-15.

58. A PNA derivative as claimed in claim 1, wherein s is 1.

59. A PNA derivative as claimed in claim 1, wherein B is, independently of any other B, a nucleobase which occurs naturally.

60. A PNA derivative as claimed in claim 1, wherein B is, independently of any other B, a nucleobase which does not occur naturally.

61. A PNA derivative as claimed in claim 1, wherein t is from 2 to 10.

62. A PNA derivative as claimed in claim 1, wherein t is from 2 to 4.

63. A PNA derivative as claimed in claim 1, wherein t is 2.

64. A PNA derivative as claimed in claim 1, wherein two adjacent R_3 and R_4 radicals form a C_5-C_8-cycloalkyl ring.

65. A PNA derivative as claimed in claim 1, wherein R_5 and R_6 are both hydrogen.

66. A PNA derivative as claimed in claim 1, wherein at least one Y or Z radical in Formula I is oxyanion or thioate in a pH range from 6.5 to 12.

67. A PNA derivative as claimed in claim 1, wherein at least one Y or Z radical in Formula I is oxyanion or thiolate in a pH range from 6.5 to 9.

68. A PNA derivative as claimed in claim 5, wherein Q is a hydroxyaminohexyl radical.

69. A PNA derivative as claimed in claim 5, wherein Q is transportan, insulin-like growth factor, a nuclear localization signal, or an affinity tag.

70. A PNA derivative as claimed in claim 69, wherein Q is a $(His)_6$ chain affinity tag.

71. A PNA derivative as claimed in claim 8, wherein X is O-(C_2-C_{22}-alkanediyl)-O.

72. A PNA derivative as claimed in claim 8, wherein X is O-$(CH_2)_{2\text{-}6}$O.

73. A PNA derivative as claimed in claim 8, wherein X is O-$(CH_2CH_2\text{-}O)_{u'}$ wherein u' is from 1 to 6.

74. A PNA derivative as claimed in claim 9, wherein Z is a C_1-C_{22}-alkoxy radical.

75. A PNA derivative as claimed in claim 9, wherein Z is C_{16}-alkoxy.

76. A PNA derivative as claimed in claim 9, wherein Z is hydroxy-C_1-C_{18}-O.

77. A PNA derivative as claimed in claim 9, wherein Z is HO-$(CH_2)_{3\text{-}12}$O.

78. A PNA derivative as claimed in claim 9, wherein Z is an aminoalkoxy radical.

79. A PNA derivative as claimed in claim 9, wherein Z is 6-aminohexoxy or 5-aminopentoxy.

80. A PNA derivative as claimed in claim 9, wherein R_9 is OH or NH_2 and m is from 1 to 6.

81. A PNA derivative as claimed in claim 9, wherein Z is HO$(CH_2CH_2$-O$)_2$.

82. A PNA derivative as claimed in claim 9, wherein Z is HO$(CH_2CH_2$-O$)_6$.

83. A PNA derivative as claimed in claim 9, wherein Z is H_2N-$(CH_2CH_2$-O$)_2$.

84. A PNA derivative as claimed in claim 9, wherein Z is a mercaptoalkoxy radical.

85. A PNA derivative as claimed in claim 9, wherein Z is 6-mercaptohexyloxy.